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ABSTRACT

In the Republic of Korea, elementary schools provide compulsory education to children between the ages of six and eleven. Students ages 12-14 attend middle school, and high schools offer three years of upper secondary education to students ages 15-17. This report describes the design of the science education program in South Korea, highlighting the revisions in the national curriculum from 1963 to the present. Particular attention is paid to the most recent curricular revision, which took place in 1980. The principal guideline for this revision was to move away from John Dewey's life-centered curriculum to a discipline-centered one, which focuses on the structure of scientific knowledge, process skills and inquiry. This document presents some of the problems and issues facing South Korean science educators as a result of the 1980 revision. These include the claims that: (1) little of the science curriculum deals with applied fields and topics of practical utility; (2) opportunities to enhance creative problem-solving abilities are very limited; (3) few chances exist to integrate technological advances and real life situations into science learning; and (4) the current curriculum overlooks the various problems of the social and environmental impacts a highly industrialized society. Recommendations designed to help rectify these problems are presented. (TW)

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PROBLEMS AND ISSUES IN SCIENCE EDUCATION IN KOREA

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Presented at U.S.-Japan Seminar on Science Education

Sponsored by the National Science Foundation

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East-West Center, Honolulu, Hawaii, USA

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I. Introduction

In the Republic of Korea, primary school provides six years of compulsory education to children between the ages of 6 and 11. Upon completion of elementary education, students ages 12 to 14 attend middle school, which offers three years of lower secondary education. The high school offers three years of upper secondary education to students ages 15 to 17.

The high schools are generally divided into two streams, academic and vocational. Students entering academic high schools generally pursue higher education after graduation, whereas those who enter vocational high schools would seek employment.

Since 1968 there has been a rapid increase in the number of middle school students. After the abolishment of the middle school entrance examination in 1968, the number of students has doubled in ten years (1969-1978), and the rate of elementary school students entering middle schools has increased from

58.4% in 1969 to 99.7% in 1985. The same trend of increase is seen in high schools. In 1985, nearly 90% of the middle school graduates entered high school.

Science is taught in primary and middle school as an integrated subject. In high school, science is separated into four fields: physics, chemistry, biology, and earth science, out of which two fields may be selected. Three to four hours per week are allotted for science education in primary and middle schools. In high school, each field is allotted two hours per week throughout the year. For students who wish to major in science, all four fields of science are required.

The current science curricula were revised in 1981. During the "national reconstruction era" (1945-1962), the science curriculum was an adjusted version of the colonial era curriculum. The first major curriculum revision took place in the decade of 1963-1972. Based on the educational philosophy of life experience initiated by John Dewey, the educational contents were selected and organized according to students' interests and demands. Hence, the curriculum content happened to emphasize rote memorization of facts, rather than developing creativity or scientific thinking.

After the completion of the first revision, the second revision followed during 1973-1974, and then the third revision took place in 1980.

The principal guideline for the third revision was to steer away from Dewey's life-centered curriculum to a discipline-centered one, which focuses on the structure of scientific knowledge and process skills or inquiry. The movement towards a

discipline-centered curriculum also attempted to introduce into the classroom what and how scientists worked.

The guidelines for the 1980 science curriculum revision stipulated that basic concepts should be emphasized and organized in the form of their interrelationships; science learning should be designed in terms of inquiry processes to help foster a meaningful understanding of the fundamental structure of science; five conceptual schemes, namely, matter, energy, interaction, change and life be used as content selection criteria. As a result, in the third revision, not much emphasis was placed on the application and effects of science.

II. Problems and Issues

The six years of implementation of the 1980 revised science curriculum has brought to focus some problems and challenges.

First, by emphasizing basic concepts or theories, the science curriculum deals very little with applied fields and topics of practical utility. As a result, the curriculum fails to arouse student interest in science. The critics of the curriculum point out that the opportunity for understanding basic concepts by exposure to practical and applied science are few, and thus chances for creative thinking are very limited. In other words, although the students may have understood the basic concepts of science, opportunity to enhance their creative problem-solving ability is very limited, as very little is provided for students to apply their science learning to real life situations and technological advances.

Science teaching which provides the understanding of technology, or its relationship to science, as a goal has yet to find its proper place in the elementary and secondary school curriculum. Many teachers, curriculum designers, teacher educators and evaluators have been feeling that the present system of science education is rather inadequate for preparing students for a fast-growing technological environment and development. They feel that in order to reflect the increasing importance and relevance of technology in our society, there is a need for reappraisal of our educational objectives and educational structures.

With the rapid changes taking place in the Republic of Korea, this is not a small problem. The social change in the Republic of Korea for the last 30 years is tremendous. In the 1950's the Republic of Korea was an agricultural-based society with small-size industries largely dependent on manual labor. In the decade of 1960's, the Republic of Korea developed into a labor-intensive light industrial nation. From 1980 onward, much effort has gone into developing a framework for highly industrialized society by shifting from heavy and chemical to high-tech and information industry. Therefore, in order to facilitate this change, there is a felt need for highly developed scientific technology.

In view of the present development trends, the Republic of Korea is expected to develop into a highly industrialized society by the 1990's. It is predicted that the demand for scientific and technological manpower will reach six million in 1991, accounting for 12% of the total population. This figure

includes 500,800 who are college graduates and above, of which high level manpower (holders of the master's degree and degrees above that level) will constitute 30% (150,000). This represents the minimum requirement for manpower at this level to realize the goal of a highly industrialized society.

In such a process of industrialization and rapid economic development, there arises an urgent need to prepare suitably qualified and skilled manpower. The employers want men with the capability to deal with modern technology, an inquiring and creative mind, a good basic understanding of science, and the ability to make decisions. But they are not getting what they want under the current curriculum. Science education has therefore so oriented itself as to contribute considerably towards the current national technological manpower demand. Science teaching should also consider that many of the young boys and girls who are educated now will be the future leaders in the government and the industry. These leaders, whether administrators or managers, must possess sufficient technological-related knowledge and judgement besides the normally necessary personal qualities. Scientific literacy and technology appreciation are essential for them to make wise decisions on matters which require some scientific and technological information. They should be taught to realize both the potential and the limitation of science and technology in its wider social and moral context.

The current curriculum of science unfortunately overlooks the various problems of the social and environmental impact of a highly industrialized society. Problems resulting from rapid

industrialization such as environmental deterioration, pollution of various kinds, destruction of ecology, and shortage of natural resources are not much incorporated in the science curriculum. As a result, the students are not provided with active involvement in science learning to develop problem-solving skills in such areas. The current curriculum also fails to give insights into problems inherent in an industrialized society such as dehumanization, or change of traditional ethics and values.

There are also many external constraints of the current curriculum. One of the major ones is the quality of science teachers. The majority of them lack teaching skills to promote and develop problem-solving ability, creativity and an inquiring mind in the students, even if they have a lot of knowledge. The pre-service programs for teachers do not, in most cases, offer an opportunity for them to develop such teaching skills. This, in fact, is one of the major factors contributing to the ineffectiveness of the teaching-learning process even after a curriculum revision.

Another impeding factor is insufficient and inadequate laboratory facilities and equipment. In principle, the science curriculum is constructed in such a way as to incorporate experiments and practices to master a basic concept. However, the current teaching methods are very much dependent upon teachers' lectures.

Last, the student evaluation methods being used are not suitable. Since evaluation is dependent only on paper and pencil tests and rote memorization of facts and not problem

solving, neither scientific thinking nor creativity is evaluated. In order to improve student learning, the development of new evaluation methods and tools is very much needed.

The college entrance examination has a mal-influence upon high school science learning. The examination is a paper and pencil test, and the competitiveness of the examination forces high school students to memorize factual knowledge rather than understand, practice, and apply their science learning. High school students finish school almost without a single experimentation; the main reason may be that the weight given to science subjects is relatively small compared with other subjects. This uneven reflection of subjects in the college entrance examination tends to influence students not to study science subjects such as physics or chemistry.

What is more, the majority of students feel that science subjects are too difficult for them to understand. The main reason for this is that the teaching of science is still essentially academically oriented and too abstract in nature. Emphasis is placed on pure science, particularly for the secondary students, with the result that many students have left school lacking an awareness of technology and a real understanding of science. More often than not, the students are drilled in memorizing important principles, formulae and facts in a textbook in order to reproduce them like a parrot in the examination. The content and approach are so formal that even good students find science too demanding and difficult to follow.

Among students, science courses have a bad reputation for being difficult. Among the natural science subjects, physics is by far the most unpopular and has a bad image in high schools. Many students in high school avoid taking physics if at all possible. Moreover, the majority of the students who take physics, chemistry and earth science feel the subjects are irrelevant to their real life needs. They are not able to relate what they learn in the science classroom with many things they come into contact with in their daily lives. The teachers get so immersed in the fundamentals of science that they lose track of the practical applications. No wonder the students feel that science is remote and coldly theoretical. As a result, science classes lose students' interest and cannot attract even the bright students' attention.

An examination of the curriculum reveals that the physics course is organized for future physicists and the chemistry course for future chemists. However, the majority of the students do not aspire to be either a physicist or a chemist. Their future career may be of wide variety and range from businessman, politician, writer, artist, historian, social worker...all the way to philosophers.

To this majority physical science's influence upon society, relationship between physics and modern technology, and everyday application of physics concepts are far more important and interesting than pure physics. Whether they become an artist or a politician, knowledge of physics must be helpful to all students. In short, in developing scientific thinking and making philosophical and scientific judgement, major amendments

need to be made in the current science curriculum.

III. Some Innovative Activities for Science Curriculum Development

By identifying and analyzing the problems of the 1980 revised science curriculum, the Korean Educational Development Institute (KEDI) is proposing the following guidelines for curriculum revision in 1986.

Guiding Principles of Science Curriculum Revision

1. Select the sequence and scope of the content based on learners' interests and needs.

The earlier practice was that the selection was done purely based on theoretical structure, linkages and internal validity of the discipline. Therefore, the content was not compatible with the interests and ability of the learners. Added to this was the excessive amount of topics covered in a given period. The coupled effect results in the reduction of time for experimental work and thus promotes rote memorization.

2. The content of science should be related to real life situations and applied science fields. It also should introduce as many examples of application of basic concepts of science in everyday life as possible.

3. It should strongly emphasize the need for the conservation of nature, alternative energy exploration search, world-wide food shortage and other problems with which industrialized

nations as well as developing ones are confronted today. Up until now these problems were only mentioned in passing. In the future, not only an introduction to the problem, but also some guidance as to how to tackle and solve such problems utilizing the multi-disciplinary approach should be incorporated into science curriculum.

4. Consideration must be taken of the sequence and continuity in the science curriculum in terms of the learner's intellectual development from primary and middle to high school levels. In the current curriculum, however, same instances or same topics are taught in different fields and at different school levels without added meaning. For example, ecology and its concepts are taught at the same level in the primary and middle school.

5. For the primary and middle school level, science should be presented as an integrated subject. There exists a close link and interdependence between science and applied sciences. The interrelationship of physics and chemistry, physics and biology, etc., should be considered while developing primary and middle school curricula. In fact the integration of content by topics or problems would provide a multi-disciplinary approach of physics, chemistry and biology to tackle a problem.

6. For the high school, the science curriculum should consist of four science fields, namely, physics, chemistry, biology and earth science. Each field would be specified at two levels; general or ordinary and advanced. In general or ordinary courses, basic knowledge, history of science, relationship between science and technological development will constitute the major portion. On the other hand, advanced courses will

concentrate on theoretical aspects and advanced topics.

Elementary Science Curriculum Development

The focus of science curriculum for the primary schools is on arousing children's interest to promote active pursuit of science learning and the development of positive attitudes and self-confidence. The science curriculum would provide learning activities to enable children to create their own ideas and enjoy themselves in science learning.

Middle School Science Curriculum

More topics related to technology and real-life problems are added to basic concepts and laws or principles. There has been criticism that the discipline-centered curriculum is too dry and too abstract for students. This results in students' losing their interest in science. To improve this, applied science and real-life problems, such as environmental pollution, conservation of nature, and alternative energy resources have been incorporated in the revised science curriculum for the middle school. The multi-disciplinary approach has also been introduced to solve these problems. In addition, the number of learning units has been reduced to ease the student's work load, which was rather heavy and incompatible with the allotted time in the current curriculum.

High School Science Curriculum

The high school science curriculum which was revised in 1981-83 came into effect in 1984. For the high schools, science is divided into four fields of physics, chemistry, biology and earth science. As previously mentioned, each field is specified at two levels, general or ordinary and advanced. In general or ordinary courses, the curriculum content comprises of basic knowledge, historical development of science, interaction of science and technology development. This course is meant for students who may study humanities or courses other than science in colleges.

Advanced courses emphasize more theoretical science and advanced topics than ordinary courses. These will be offered to would-be science majors in colleges. Each course contains some problems, including various pollutions caused by technology, energy crisis, nature preservation, etc. Additionally, in the 1981 revision, much emphasis has been placed on the science teaching of vocational high schools. Three or more fields of science will be offered as a requirement in the revised curriculum, while one or two more science courses will be offered as an elective in current curriculum.

IV. Concluding Remarks

First of all, the major stumbling block is that many specialists from colleges and universities still insist upon including a body of abstract knowledge in school science curricula and show little or no interest in the applied fields and technology.

As a matter of fact, incorporating technology into the basic science course implies introducing a flavor of creative technology in a school. It means allowing students to get themselves involved in technological activities and projects which include the process of creative problem-solving, decision-making, and finally the actual implementation or construction. In recent years, project work has been increasingly considered by many curriculum specialists to be a very essential and integral part of a school physics or chemistry and technology program. It is growing in popularity and spreading quickly in schools, especially in the highly industrialized countries. Experience so far has shown that project work can help the students identify and foster many abilities which are normally ignored or not possible in the traditional textbook-centered learning. The everyday technological environment provides a wealth of interesting practical problems for students to tackle. In the process of active participation and investigation, they can acquire invaluable real-life experiences such as identifying a problem, making a decision, designing a solution, applying this knowledge purposefully, and learning new skills, which go a long way to develop competence and creativity.

But such project methods do not attract the attention of science curriculum specialists from colleges. Some of them who are familiar with this method hesitate to introduce such methods because there is a dearth of qualified teachers to teach and use them well.

Second, the goal of integrated science for primary and middle schools proposed by KEDI is not achieved as much as was expected. Some specialists have negative attitudes toward the integration of science because of the current system of pre-service teacher education. That is, teachers have been trained to be a physics, chemistry or biology teacher instead of integrated science teachers.

Thirdly, there is a lack of facilities and proper laboratories. Also, crowded classrooms do not allow students to have enough space to conduct laboratory work.

Due to insufficient and inadequate facilities and equipment, only a few schools can provide students with laboratory work and practical tasks suggested by the curriculum. Actually, experiments are not practiced in some middle and high schools. Therefore, many teachers even express their dislike towards incorporating many experiments into the curriculum.

These are the most urgent problems to be solved in the country. These problems prevent KEDI from introducing new topics such as project methods in science curriculum revision.